

**The *Penenirmus* (Mallophaga: Isechnocera) of the Picidae
(Aves: Piciformes)**

ROBERT C. DALGLEISH

DEPARTMENT OF BIOLOGICAL SCIENCES, UNION COLLEGE, SCHENECTADY, NEW YORK, 12308

AND

BIOLOGICAL RESEARCH STATION, EDMUND NILES HUYSCK PRESERVE, RENSSELAERVILLE,
NEW YORK

RECEIVED FOR PUBLICATION MAY 3, 1972

Abstract: Eight species of *Penenirmus* from the Picidae are recognized and discussed. Neotypes are established from *P. serrilimbus* (Burmeister, 1838) and *P. heteroscelis* (Nitzsch, 1866). *Paranirmus* Zlotorzycska, 1964, is considered congeneric with *Penenirmus*. New synonymies include: *P. macrotrichus* (Kolenati, 1858) and *P. tuktola* (Ansari, 1947) (= *P. pici* (Fabricius, 1798)); *P. fiebrigi* Eichler, 1953, *P. serrilimbus asyndesmus* Emerson and Johnson, 1961, *P. s. pileatus* Emerson and Johnson, 1961, *P. pici rivolii* (Carriker, 1963), *P. p. caurensis* (Carriker, 1963) and *P. silesiacus* Zlotorzycska, 1966 (= *P. auritus* (Scopoli, 1763)); *P. accuratus* Zlotorzycska, 1964 (= *P. heteroscelis* (Nitzsch)); *P. villosus* Emerson and Johnson, 1961 (= *P. jungens* (Kellogg, 1896)). Species from 18 genera and 60 species of Picidae were examined. A key is given, and all species are illustrated and or re-described.

Penenirmus Clay and Meinertzhagen, 1938

Penenirmus Clay and Meinertzhagen, 1938, Entomologist **71**: 73.

Type species: *Pediculus albiventris* Scopoli, 1763

Picophilopterus Ansari, 1947, Proc. natl. Inst. Sci., India **13**: 265.

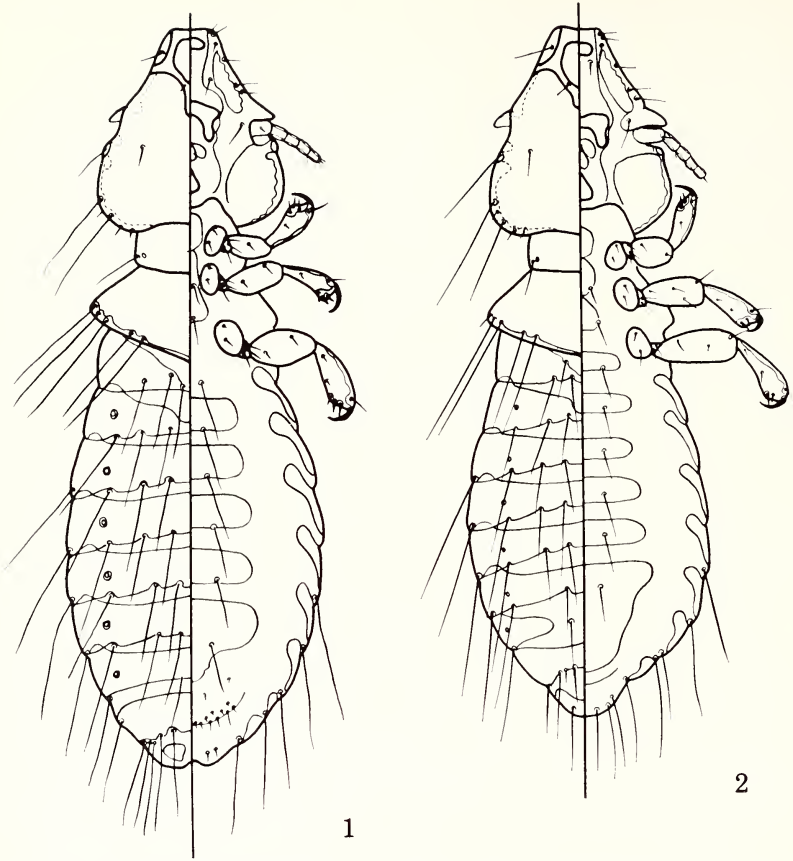
Type species: *Picophilopterus tuktola* Ansari, 1947. (Erected for species found on the Picidae).

Paranirmus Zlotorzycska, 1964, Acta Parasitologica Polonica 12: 275.

Type species: *Nirmus heteroscelis* Nitzsch, 1866. NEW SYNONYMY.

Penenirmus is known from the Passeriformes and Piciformes. Its distribution among these orders is poorly known, though it would appear that all of the Picidae are infested. This genus is more commonly collected than any of the other Mallophaga found on the Picidae. Species included herein are, for the present, considered congeneric with those known from the passerines and other families of Piciformes. These species do however form a well defined group which is recognized by the absence of a postantennal suture, the presence of anterior median notches on tergites II–III, and basal sclerites on the penis.

Acknowledgments: I wish to thank Dr. Theresa Clay, British Museum (Natural History), Dr. K. C. Emerson, Arlington, Virginia, Dr. Robert E. Elbel, Dugway, Utah and Dr. Roger D. Price, University of Minnesota, for their assistance during this study, including the loan of many valuable specimens.



FIGS. 1 & 2. *Penenirmus auritus* (Scopoli), dorsal and ventral views of (1) female and (2) male. Drawn to the same scale.

Carriker (1963: 33) recommended that *Picophilopterus* Ansari, 1947, be re-erected for this group. This action, in my opinion, in the absence of well defined generic limits and the great amount of undescribed "*Penenirmus*," was premature and I prefer to withhold any decision on the taxonomic placement of this and other *Penenirmus* species groups until these deficiencies are removed.

All specimens examined were mounted on slides. Descriptions, illustrations and measurements are based on specimens macerated in hydroxide, cleared, and mounted in Canada Balsam. The nomenclature of the hosts follows that of Peters (1948).

Identification of the species discussed herein is based for the most part on chaetotaxy. It is necessary, in the case of abdominal chaetotaxy, to consider the total or the mean number of centroposterior setae of the sternites or tergites III-VI, rather than the number on any one segment. The chaetotaxy of the

head is more reliable, though occasional specimens with an abnormal number of setae will be encountered. It is, however, possible to recognize the atypical, in almost every case, by position of adjacent setae. The number of centroposterior setae on the dorsal margin of the pterothorax is a reliable character, though the position of these setae is not. This central group of setae on the pterothorax is usually widely separated from the lateral groups, though an almost continuous row of evenly spaced setae is not uncommon.

Many species and subspecies erected by previous authors are based, in part, on differences in the shape of the dorsal anterior plate of the forehead. During this study, this structure was routinely outlined and its proportions compared with those of the head. The variation in this plate as found in *P. auritus* from two hosts is presented graphically (Figs. 15, 16). It would appear that this structure is readily altered by different techniques in mounting, probably depending upon the degree of maceration, though it may also exhibit considerable "natural" variation; in either case it is too variable to be of taxonomic use.

KEY TO THE SPECIES OF *Penenirmus* FROM THE PICIDAE

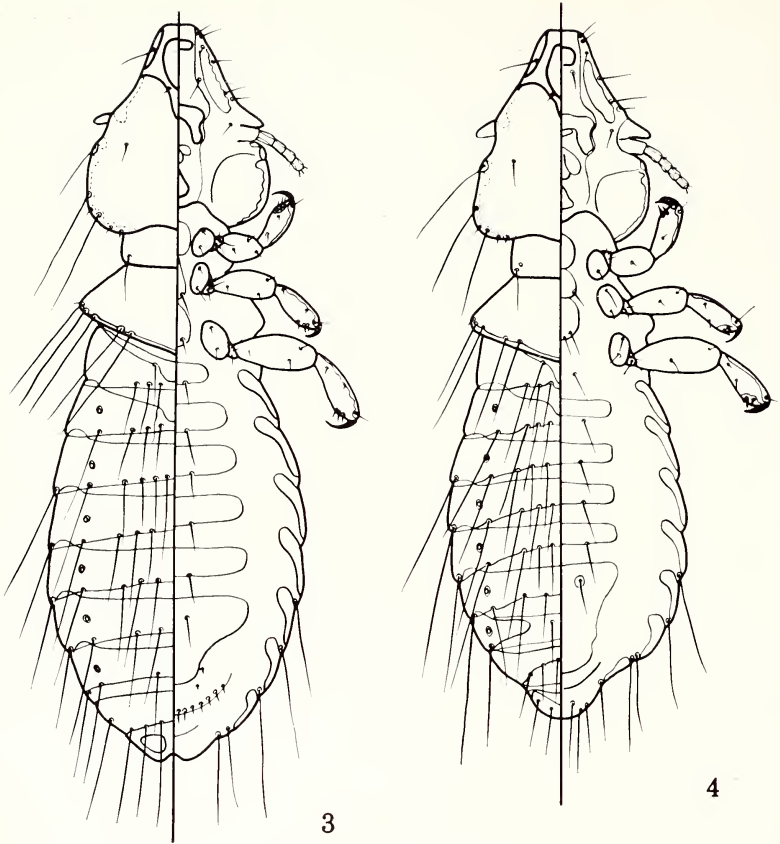
1. Temporal setae 1, 2 and 3 elongate, others short and inconspicuous (Figs. 9, 10). 2
- Temporal setae 1 and 3 elongate, seta 2 and others short and inconspicuous (Figs. 11-14). 3
2. Temporal seta 2 slender, basal diameter less than that of 1 or 3; preantennal region short (Fig. 10). *arcticus*
- Basal diameter of temporal seta 2 equal to that of 1 and 3; preantennal region as long as postantennal region. (Fig. 9). *serrilimbus*
3. Pterothorax with 4 centroposterior setae (Figs. 1-4). 4
- Pterothorax with 6 or more centroposterior setae (Figs. 5-8). 5
4. Centroposterior setae of tergites IV, V and VI total less than 16 (Figs. 1, 2). *auritus*
- Centroposterior setae of tergites IV, V and VI total 16 or more (Figs. 3-4). *pici*
5. Anterior dorsal setae of forehead longer than the distance between them (Fig. 14). *heteroscelis*
- Anterior dorsal setae of forehead shorter than the distance between them (Fig. 13). 6
6. Sternites with an average of 4 centroposterior setae; segments IV and V each with 2 pairs of pleural setae. *campephili*
- Sternites with an average of 2 centroposterior setae; segments IV and V each with 1 pair of pleural setae. 7
7. Centroposterior setae of tergites IV, V and VI total less than 16. *jungens*
- Centroposterior setae of tergites IV, V and VI total 16 or more. *maculipes*

Penenirmus arcticus Carriker, 1958

(Fig. 10)

Type host: *Picoides arcticus* (Swainson)

Penenirmus arcticus Carriker, 1958, Proc. ent. Soc. Washington **60**: 168, Figs. 1, 2. Type host: *Picoides arcticus*.



FIGS. 3 & 4. *Penenirmus pici* (Fabricius), dorsal and ventral views of (3) female and (4) male. Drawn to the same scale.

Penenirmus californiensis arcticus Carriker; Emerson and Johnson, 1961 J.

Kansas ent. Soc. **34**: 39, Figs. 10, 17, 27. Hosts: *Picoides arcticus* and *P. tridactylus bacatus* Bangs.

The short, broad head (Fig. 10), with temporal seta 2 slender and elongate, distinguishes this species from all others known from the Picidae.

The preantennal length is conspicuously shorter than the postantennal length of the head. Lateral margins of forehead are convex rather than straight or concave as in other species. Temporal setae 1, 2 and 3 elongate, 2 approximately half the basal diameter of either 1 or 3. Pterothorax with 4 centroposterior setae. Centroposterior setae of tergites IV-VI total less than 16 (\bar{x} 4/tergites). Centroposterior setae of sternites IV-VI total less than 9 (\bar{x} 2/sternite). Abdomen similar in proportions to that of *P. auritus*.

The original description is based on a series of 4 pairs, reported as being

left too long in hydroxide. The type series is not mounted in Canada Balsam and the medium is vacuolated. The types have been compared with better prepared material and differ only in features attributable to the excessive maceration.

Dimensions in mm.: Total length, male 1.70, female 1.78–1.87; head length, male 0.51, female 0.52–0.56; head width, male 0.45, female 0.46–0.53; prothorax width, male 0.29, female 0.26–0.30; pterothorax width, male 0.45, female 0.45–0.49; abdominal width, male 0.60, female 0.64–0.70.

Material examined: 3 males, 2 females from *Picoides arcticus* (Swainson) from Canada and U. S. A.; 2 females from *Picoides tridactylus crissoleucus* (Reichenbach) from Siberia.

Penenirmus serrilimbus (Burmeister, 1838)

(Fig. 9)

Type-host: *Jynx torquilla* Linn.

Docophorus serrilimbus Burmeister, 1838, Handb. Ent. **2**(2): 427. Host: *Jynx* (sic) *torquilla*.

Docophorus serrilimbus N.; Giebel, 1866, Z. ges. Nat. Wiss. **28**: 360. Host: *Jynx* (sic) *torquilla*.

Philopterus serrilimbus Nitzsch; Harrison, 1916, Parasitology **9**: 104. Host: *Jynx* (sic) *torquilla*.

Philopterus serrilimbus (Nitzsch); Seguy, 1944, Faune de France **43**: 238, Figs. 354, 355. Host: *Jynx torquilla*.

Penenirmus serrilimbus (Burmeister); Hopkins and Clay, 1952, Check list of genera and species of Mallophaga: 276. Host: *Jynx torquilla*.

Penenirmus serrilimbus serrilimbus (Burmeister); Emerson and Johnson, 1961, J. Kansas ent. Soc. **34**: 39, Figs. 9, 19, 28. Host: *Jynx torquilla*.

This species is readily distinguished from others of this group by the 3 pairs of equally robust, elongate temporal setae. The elongate forehead (Fig. 9) distinguishes *P. arcticus* for which the abdominal chaetotaxy is identical.

Dr. Clay has examined 27 males and 53 females from the type host from Spain, United Kingdom, Czechoslovakia, India and Afghanistan, and 1 male and 2 females from *Jynx rufficollis* Wagler, and found them all to agree with this diagnosis.

The Burmeister types are lost and there has been no subsequent neotype designation for *Docophorus serrilimbus* Burmeister, 1838. The male on slide No. 11121 from a *Jynx torquilla torquilla* from Norfolk, England, June, 1938, Meinertzhagen, British Museum, is hereby designated Neotype and the 5 females on that slide are Neoparatypes. This slide has been so labeled and deposited in the British Museum (Natural History). The neotype agrees with the original description and preserves the identity of this species, about which there has been no disagreement.

Dimensions in mm.: Total length, male 1.76–1.96, female 2.00–2.39; head length, male 0.50–0.55, female 0.55–0.57; head width, male 0.43–0.46, female 0.46–0.52; prothorax width, male 0.25–0.28, female 0.28–0.30; pterothorax width, male 0.39–0.45, female 0.43–0.50; abdominal width, male 0.55–0.62, female 0.64–0.73.

Material examined: 1 male, 4 females from *Jynx torquilla* from Thailand and Spain; 1 male, 13 females from *Jynx torquilla torquilla* from England, India and Pakistan.

Penenirmus auritus (Scopoli, 1763)

(Figs. 1, 2, 11)

Type host: *Dendrocopos major pinetorum* (Brehm)

Pediculus auritus Scopoli, 1763, Ent. carniolica: 383. Hosts: *Pico Majore* and *Martio*. (in part)

Philopterus auritus Scopoli; Harrison, 1916, Parasitology **9**: 11, 88. Host: *Picus* spp. (*superciliosus* Nitzsch placed as a synonym)

Philopterus auritus (Scopoli); Seguy, 1944, Faune de France **43**: 238, Figs. 350, 351, 352, 353. Hosts: *Picus viridis*, *Dryobates major*, *D. medius*, *Picus canus*. (in part; *pici* Fabr., *scalaris* Nitzsch, and *superciliosus* Burmeister, placed as synonyms)

Penenirmus auritus (Scopoli); Clay and Hopkins, 1951, British Mus. (Nat. Hist.), Bull ent. **2**: 14, Figs. 19, 20, Pl. 1, Fig. 4. (Neotype selected, *superciliosus* Burmeister placed as a synonym)

Penenirmus auritus auritus (Scopoli); Emerson and Johnson, 1961, J. Kansas ent. Soc. **34**: 35, Figs. 5, 20, 23. Host: *Dendrocopos major pinetorum* (C. L. Brehm).

Docophorus superciliosus Burmeister, 1838. Handb. Ent. **2**(2): 427. Host: *Pic. major*.

Docophorus superciliosus N.; Giebel, 1861, Z. ges. Nat. Wiss. **18**: 305. Host: *Picus major*.

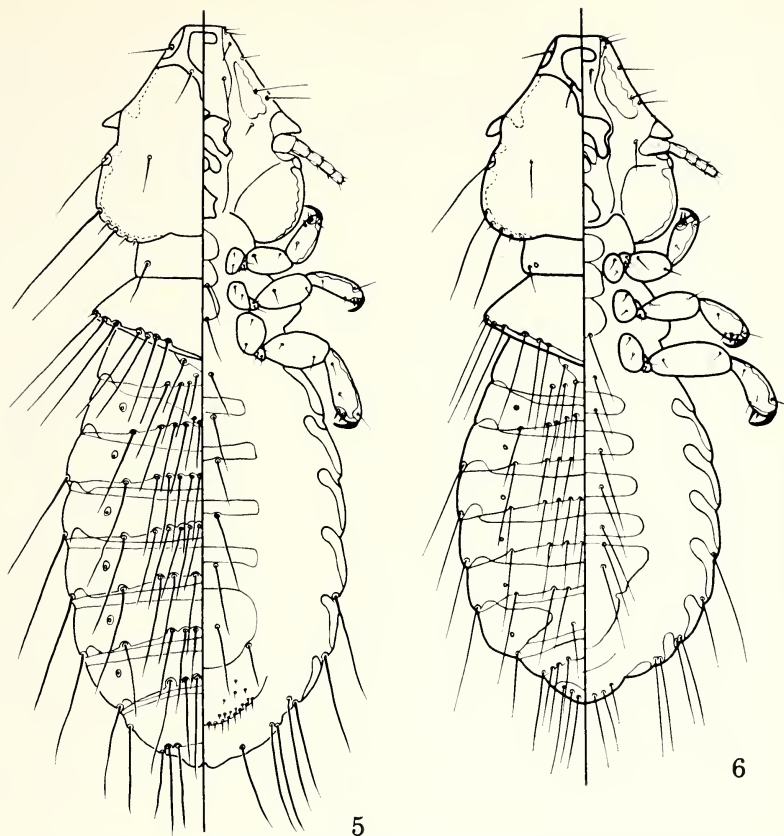
Penenirmus superciliosus (Burmeister); Clay and Hopkins, 1951, British Mus. (Nat. Hist.), Bull ent. **2**: 15. Type host: *Dendrocopos major major* Linn. (Neotype selected, placed as a synonym of *auritus* Scopoli)

Docophorus californiensis Kellogg, 1896, Occ. Pap. California Acad. Sci. (2), **6**: 483, Pl. 66, Fig. 6. Host: *Melanerpes formicivorus bairdi* Ridgway.

Philopterus californiensis Kellogg; Harrison, 1916, Parasitology **9**: 90. Host: *Melanerpes* spp.

Penenirmus californiensis (Kellogg); Hopkins and Clay, 1952, Check list of genera and species of Mallophaga: 274. Host: *Melanerpes formicivorus bairdi* Ridgway.

Penenirmus auritus californiensis (Kellogg); Carriker, 1956, Florida ent. **39**:



FIGS. 5 & 6. *Penenirmus heteroscelis* (Nitzsch), dorsal and ventral views of (5) female and (6) male. Drawn to the same scale.

34, Figs. 30, 31. Hosts: *Melanerpes f. formicivorus* (Swainson), *Melanerpes formicivorus flavigula* (Malherbe).

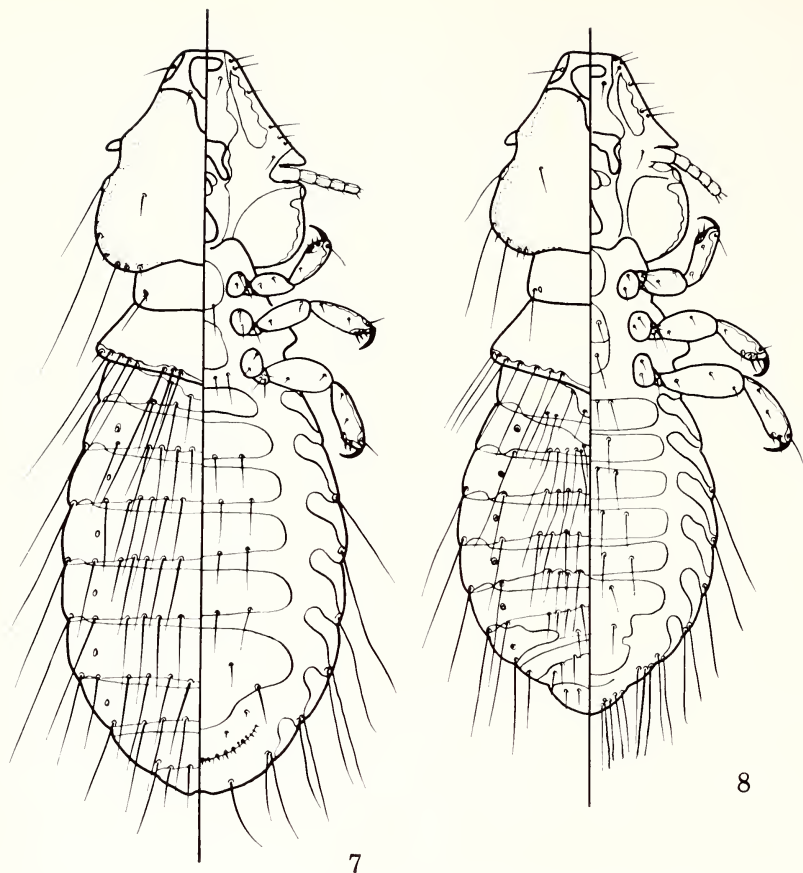
Penenirmus californiensis californiensis (Kellogg); Emerson and Johnson, 1961, J. Kansas ent. Soc. **34**: 36, Figs. 7, 16, 25. Hosts: *Melanerpes formicivorus*, *Melanerpes erythrocephalus* (Linn.).

Docophorus evagens Kellogg, 1896, Occ. Pap. California Acad. Sci. (2), **6**: 480, Pl. 66, Fig. 2. Host: *Dendrocopos pubescens* (Linn.).

Penenirmus evagens (Kellogg); Hopkins and Clay, 1952, Check list of genera and species of Mallophaga: 274. Host: *Dendrocopos pubescens* (Linn.)

Penenirmus auritus evagens (Kellogg); Carriker, 1956, Florida ent. **39**: 35, Fig. 32. Hosts: *Dendrocopos pubescens*, *Dendrocopos scalaris giraudi* (Stone).

Penenirmus varius Emerson, 1953, J. Kansas ent. Soc. **26**: 134, Figs. 6, 8. Hosts: *Sphyrapticus v. varius* (Linn.), *Sphyrapticus v. nuchalis* Baird.



FIGS. 7 & 8. *Penenirmus campephili* Eichler, dorsal and ventral views of (7) female and (8) male. Drawn to the same scale.

Penenirmus auritus varius Emerson; Carriker, 1956, Florida ent. **39**: 37, Fig. 33. Host: *Sphyrapticus v. varius*.

Penenirmus californiensis varius Emerson; Emerson and Johnson, 1961 J. Kansas ent. Soc. **34**: 38, Figs. 8, 22, 26. Host: *Sphyrapticus varius varius*, *Sphyrapticus v. appalachiensis* Ganier, *Sphyrapticus v. nuchalis* Baird, *Sphyrapticus v. ruber* (Gmelin), *Sphyrapticus v. daggetti* Grinnell.

Penenirmus fiebrigi Eichler, 1953, Zool. anz. **150**: 240, Figs. 2, 7, 11. Host: *Colaptes campestris campestroides* (Malherbe). NEW SYNONYMY.

Penenirmus serrilimbus fiebrigi Eichler; Emerson and Johnson, 1961 J. Kansas ent. Soc. **34**: 40.

Penenirmus peusi Eichler, 1953, Zool. anz. **150**: 242, Figs. 4, 9, 11, 18. Host: *Dendrocopos syriacus balianicus* (Gengler and Stresemann).

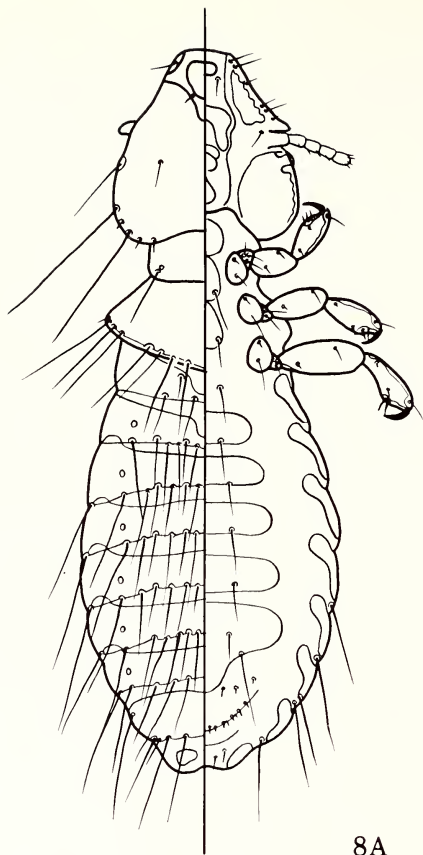
- Penenirmus auritus peusi* Eichler; Emerson and Johnson, 1961, J. Kansas ent. Soc. **34**: 36.
- Penenirmus auritus aurifrons* Carriker, 1956, Florida ent. **39**: 37, Figs. 34, 35. Host: *Melanerpes aurifrons grateloupensis* (Lesson).
- Penenirmus serrilimbus aurifrons* Carriker; Emerson and Johnson, 1961, J. Kansas ent. Soc. **34**: 39, Figs. 9, 19, 29. Hosts: *Melanerpes a. aurifrons* (Wagler), *Melanerpes c. carolinus* (Linn.).
- Penenirmus serrilimbus asyndesmus* Emerson and Johnson, 1961, l.c.: 40, Figs. 12, 21, 31. Host: *Asyndesmus lewis* (Gray). NEW SYNONYMY.
- Penenirmus serrilimbus pileatus* Emerson and Johnson, 1961, l.c.: 40, Figs. 11, 18, 30. Hosts: *Dryocopus pileatus abieticola* (Bangs), *Dryocopus pileatus pileatus* (Linn.). NEW SYNONYMY.
- Picophilopterus pici rivolii* Carriker, 1963, Mem de la soc Ciencias Naturales la Salle **23** (63): 35, pl. 9, Figs. 1, 3. Host: *Piculus rivolii meridae* (Chapman). NEW SYNONYMY.
- Picophilopterus pici caurensis* Carriker, 1963, l.c.: 35, pl. 9, Fig. 2. Host: *Veniliornis passerinus modestus* Zimmer. NEW SYNONYMY.
- Penenirmus silesiacus* Zlotorzyska, 1964, Acta Parasit. Polonica **12**(24): 273, Figs. 9F, 9G. Host: *Dryobates medius* (L.) NEW SYNONYMY.

Penenirmus auritus (Figs. 1, 2) is distinguished from others known from the Picidae by the 4 elongate setae on the temples, 2 short anterior dorsal setae of the forehead, fewer than a total of 16 centroposterior setae on tergites IV-VI (\bar{x} = 4/tergite) and less than a total of 9 centroposterior setae on sternites IV-VI (\bar{x} = 2/sternite).

The preantennal length of the head (Fig. 11) approximates the postantennal length. Anterior dorsal setae of forehead short and stout. Temporal setae 1 and 3 elongate, 2, 4 and 5 short and inconspicuous. Pterothorax and tergites III-VI each with an average of 4 elongate centroposterior setae. Sternites III-VI each with 2-3 centroposterior setae.

Carriker (1957: 96) selected the male on slide No. 361a as the lectotype of *P. californiensis* Kellogg. This designation was made while the specimen was in the original mountant of gelatin, which had darkened and vacuolated, thus obscuring the specimen. Upon remounting, 1 female and 2 immatures were found, not 1 male, 1 female and 1 immature as reported by Carriker. In that there is no male on slide 361a, Carriker's lectotype designation is emended to read: the female on slide 361a is selected as lectotype and the slide is so labeled. Paralectotypes are recorded from the Snow Museum, University of Kansas; Cornell University; University of California at Berkeley; and the United States National Museum.

The female lectotype of *P. evagens* Kellogg, selected by Carriker (1957: 96) on slide No. 307a, was not available for study. Slide No. 311a, labeled "*Dryobates pubescens*, *Docoph. evagens* K. n.sp., (near *P. superciliosus*), N.M.



8A

FIG. 8A. *Penenirmus maculipes* (Piaget), dorsal and ventral views of holotype female.

II., fig'd'' has been remounted, examined and labeled paralectotype. Slides 361a, 307a and 311a are in the Kellogg Collection of the University of California at Berkeley.

The subspecies of *P. auritus*, *P. californiensis* and *P. serrilimbus*, recognized by Emerson and Johnson (1961), are based on the shape of the dorsal anterior plate of the forehead and chaetotaxy of the pterothorax and vulva. These characters are not reliable as considerably overlapping inter- and intrapopulation variation is evident in large series. The outlines of dorsal anterior plates are given (Figs. 15, 16) for specimens taken from 2 species of hosts. With the exception of *P. serrilimbus serrilimbus* and *P. californiensis arcticus*, these subspecies are considered to be conspecific with *P. auritus*.

Likewise the erection of *P. silesiacus* Zlotorzycska, 1964, for a single female and one immature is both unwarranted and unsupported. The features dis-

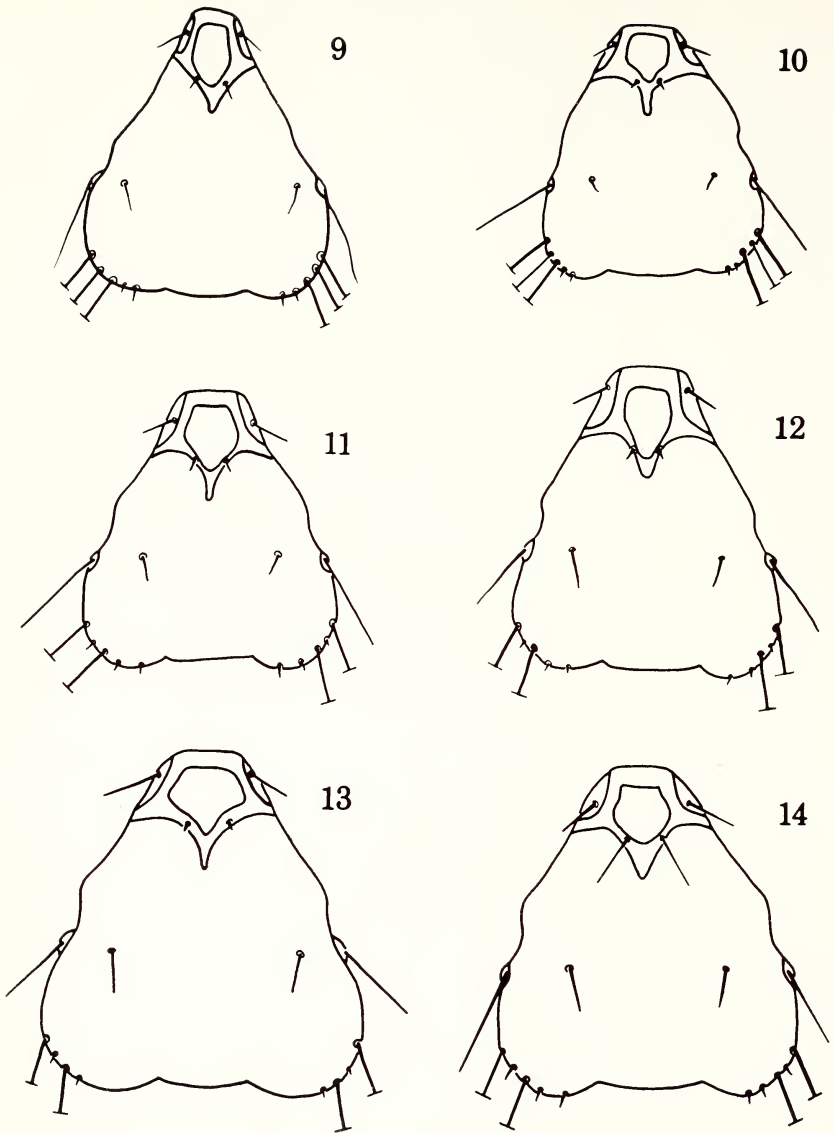
cernible from the drawing and photograph and those of the brief description, fall within the range of variation of *P. auritus*, which appears to infest all *Dendrocopos* species.

Neither the original descriptions nor specimens examined from the type hosts of *P. fiebrigi* Eichler, 1953, *P. pici rivolii* (Carriker, 1963) and *P. pici caurensis* (Carriker, 1963), contained characters, which in my opinion, warrant the erection of these new taxa.

Prior to 1963 Carriker considered *Penenirmus* from the new world Picidae to be subspecies of *P. auritus*. In his study of the Mallophaga from Venezuelan birds (Carriker, 1963:34) however, he places them all as subspecies of *P. pici* and re-erects *Picophilopterus* Ansari, 1947, for the *Penenirmus* from the Picidae.

Dimensions in mm.: Total length, male 1.39–2.08, female 1.63–2.36; head length, male 0.42–0.59, female 0.48–0.64; head width, male 0.30–0.55, female 0.41–0.59; prothorax width, male 0.20–0.35, female 0.24–0.40; pterothorax width, male 0.34–0.56, female 0.35–0.63; abdominal width, male 0.41–0.79, female 0.50–0.92.

Material examined: 1 male from *Picummus cinnamomeus* Wagler from Colombia; 2 males, 1 female from *Picummus olivaceus* Lafresnaye from Colombia; 1 female from *Picummus innominatus* Burton from Thailand; 1 male, 2 females from *Colaptes campestris* (Vieillot) from Paraguay; 2 males, 3 females from *Colaptes campestris campestroides* (Malherbe) from Paraguay; 1 male, 1 female from *Chrysoptilus punctigula striatigularis* Chapman from Colombia; 1 female from *Chrysoptilus punctigula ujhelyi* Madarasz from Colombia; 2 males, 2 females from *Chrysoptilus atricollis peruvianus* Rlichenbach from Peru; 9 males, 9 females from *Piculus rivolii rivolii* (Boissonneau) from Colombia; 10 males, 11 females from *Piculus rivolii brevirostris* (Taczanowski) from Colombia and Peru; 4 males, 4 females from *Piculus rivolii atriceps* (Sclater and Salvin) from Peru; 1 female from *Piculus rubiginosus alleni* (Bangs) from Colombia; 6 males, 5 females from *Piculus rubiginosus uropygialis* (Cabanis) from Costa Rica; 1 male, 1 female from *Piculus rubiginosus yucatanensis* (Cabot) from Yucatan; 4 males, 4 females from *Micropternus brachyurus phaiiceps* (Blyth) from Thailand; 3 males, 7 females from *Micropternus brachyurus squamigularis* (Sundevall) from Thailand; 1 male, 1 female from *Picus chlorolophus* Vieillot from Thailand; 1 male from *Picus mineaceus* Pennant from Malaya; 2 males, 3 females from *Picus mineaceus malaccensis* Latham from North Borneo; 1 male from *Dryocopus pileatus* (Linn.) from U.S.A.; 2 females from *Dryocopus pileatus pileatus* (Linn.) from U.S.A.; 5 males, 8 females from *Dryocopus pileatus abieticola* (Bangs) from U.S.A.; 3 males, 5 females from *Dryocopus lineatus* (Linn.) from Yucatan and Trinidad; 1 male, 3 females from *Dryocopus lineatus petersi* (van Rossem) from Mexico; 5 males, 10 females from



FIGS. 9-14. Dorsal view of heads drawn to the same scale. (9) *P. serrilimbus*, (10) *P. arcticus*, (11) *P. auritus*, (12) *P. pici*, (13) *P. campephili*, (14) *P. heteroscelis*.

Asyndesmus lewis (Gray) from U.S.A.; 35 males, 28 females from *Melanerpes erythrocephalus* (Linn.) from Canada and U.S.A.; 4 males, 11 females from *Melanerpes formicivorus* (Swainson) from U.S.A.; 5 males, 5 females from *Melanerpes formicivorus formicivorus* (Swainson) from U.S.A.; 7 males, 6 females from *Melanerpes formicivorus bairdi* Ridgway from U.S.A.; 5 males,

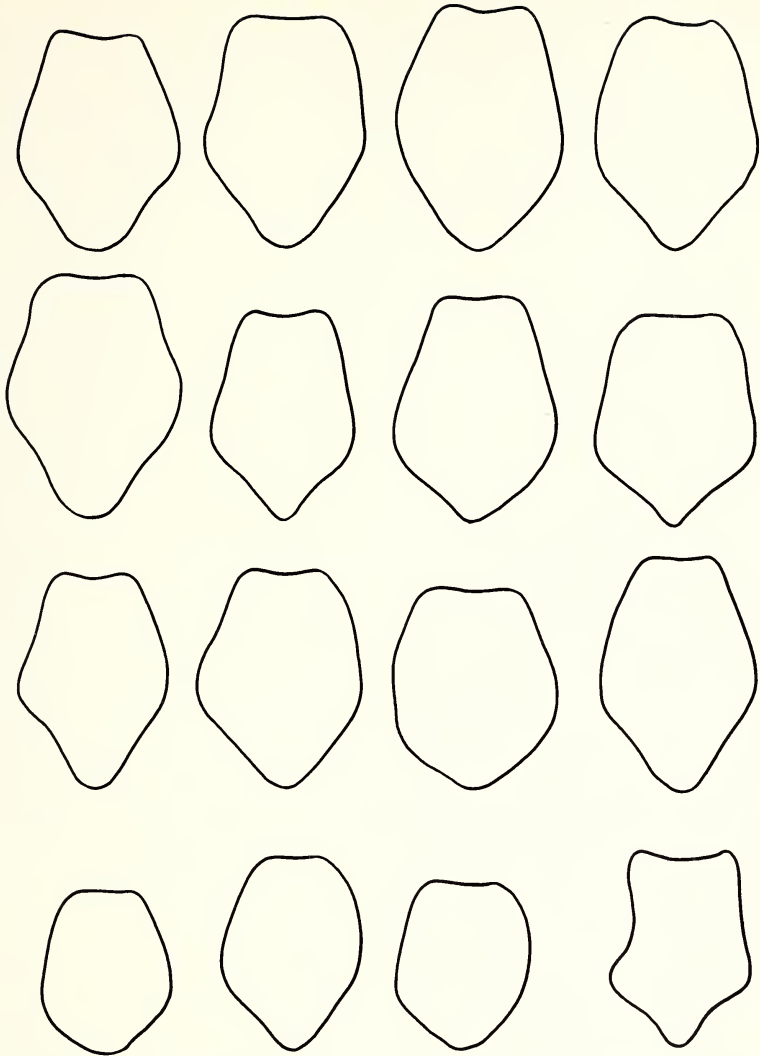


FIG. 15. Outline of dorsal anterior plate of foreheads of *P. auritus* from *Melanerpes erythrocephalus* from various localities. Scale adjusted so that the head width is the same in each case.

8 females from *Melanerpes formicivorus flavigula* (Malherbe) from Colombia; 4 males, 6 females from *Melanerpes formicivorus striatipectus* (Ridgway) from Costa Rica; 4 males, 8 females from *Melanerpes hypopolius albescens* (van Rossem) from U.S.A.; 9 males, 15 females from *Melanerpes carolinus* (Linn.) from U.S.A.; 2 males, 9 females from *Melanerpes aurifrons* (Wagler) from U.S.A.; 4 males, 6 females from *Melanerpes aurifrons grateloupensis* (Lesson)

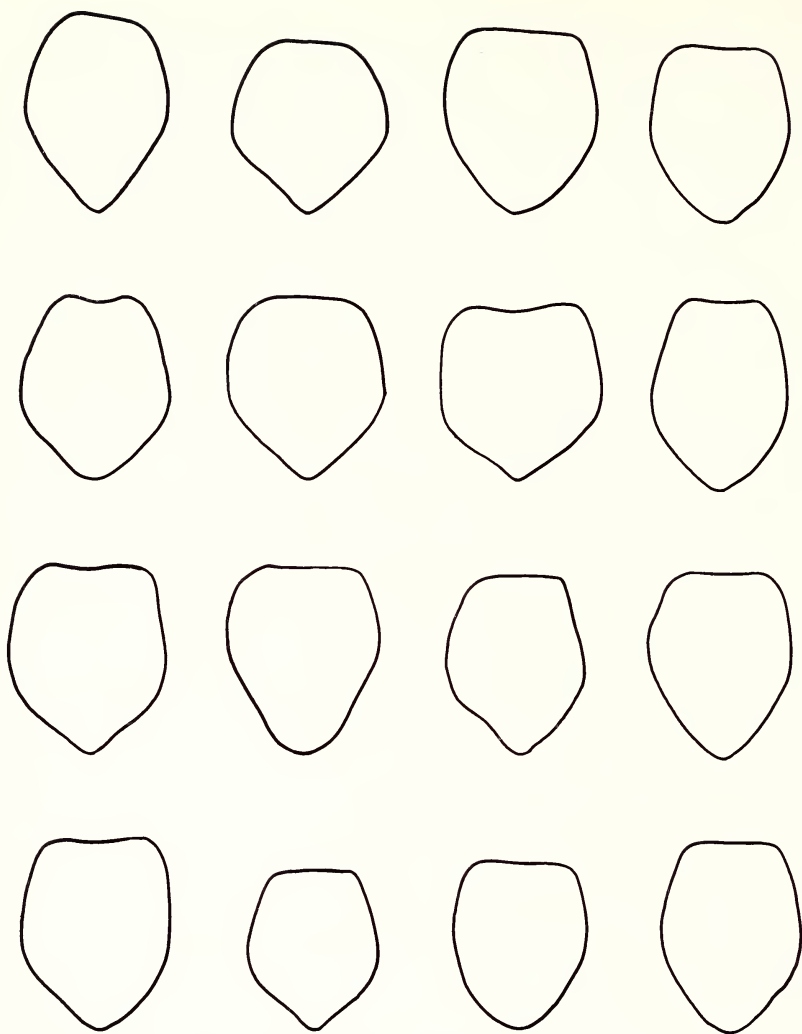


FIG. 16. Outline of dorsal anterior plates of foreheads of *P. auritus* from *Sphyrapticus varius* from various localities. Scale adjusted so that the head width is the same in each case.

from Mexico; 8 males, 8 females from *Melanerpes superciliaris nycanus* (Ridgway) from Bahama Islands; 2 males, 2 females from *Melanerpes cruentatus cruentatus* (Boddaert) from Peru, Bolivia and Colombia; 37 males, 46 females from *Sphyrapticus varius* (Linn.) from Canada and U.S.A.; 22 males, 29 females from *Sphyrapticus varius varius* (Linn.) from Canada and U.S.A.; 19 males, 16 females from *Sphyrapticus varius nuchalis* Baird from U.S.A.; 2 males, 2 females from *Sphyrapticus varius ruber* (Gmelin) from

U.S.A.; 5 males, 5 females from *Sphyrapticus thyroideus* (Cassin) from Mexico and U.S.A.; 1 male from *Veniliornis fumigatus* (d'Orbigny) from Mexico; 1 male from *Veniliornis kirkii cecillii* (Malherbe) from Colombia; 2 males, 9 females from *Veniliornis callonotus major* (Berlepsch and Taczanowski) from Peru; 2 males, 1 female from *Veniliornis dignus* (Sclater and Salvin) from Colombia; 19 male and 24 female Neoparatypes from *Dendrocopos major major* (Linn.) from Estonia; Neotype male and 3 male and 4 female Neoparatypes from *Dendrocopos major pinetorum* (C. L. Brehm) from Poland; 6 males, 8 females from *Dendrocopos darjellensis* (Blyth) from Sikkim; 6 males, 4 females from *Dendrocopos leucotos* (Bechstein) from Formosa; 3 males, 5 females from *Dendrocopos hyperythrus hyperythrus* (Vigors) from Nepal; 1 male, 1 female from *Dendrocopos atratus* (Blyth) from Thailand; 2 males, 2 females from *Dendrocopos macei macei* (Vieillot) from India; 3 males, 5 females from *Dendrocopos minor minor* (Linn.) from Estonia; 2 females from *Dendrocopos kizuki* (Temminck) from Korea; 3 males, 12 females from *Dendrocopos albolarvatus* (Cassin) from U.S.A.; 7 males, 21 females from *Dendrocopos villosus* (Linn.) from Bahama Is., Canada and U.S.A.; 6 males, 4 females from *Dendrocopos villosus hyloscopus* (Cabanis and Heine) from U.S.A.; 2 males, 1 female from *Dendrocopos villosus harrisii* (Audubon) from U.S.A.; 3 males, 8 females from *Dendrocopos villosus extimus* (Bangs) from Costa Rica; 9 males, 11 females from *Dendrocopos pubescens* from U.S.A.; 1 female from *Dendrocopos pubescens medianus* (Swainson) from U.S.A.; 8 females from *Dendrocopos scalaris* (Wagler) from Mexico and U.S.A.; 3 females from *Dendrocopos scalaris giraudi* (Stone) from Mexico; 1 male from *Dendrocopos scalaris symplectus* (Oberholser) from U.S.A.; 1 male, 3 females from *Dendrocopos arizonae* (Hargitt) from Mexico;

Penenirmus pici (Fabricius, 1798)

(Figs. 3, 4, 12)

Type host: *Picus viridis* Linnaeus

Pediculus pici Fabricius, J. C., 1798, Ent. Syst. Suppl.: 571. Host: *Pico viridi*.

Phlopterus pici Fabr.: Harrison, 1916, Parasitology **9**: 17, 102. Host: *Picus* spp. (*scalaris* Nitzsch, placed as a synonym)

Penenirmus pici (J. C. Fabricius); Hopkins and Clay, 1952, Check list of general and species of Mallophaga: 275. Host: *Picus viridis* Linn. (*scalaris* Burmeister, placed as a synonym)

Docophorus scalaris Burmeister, 1838, Handb. Ent. **2**(2): 427. Hosts: *Pic. viridis*, *canus*, *medius*.

Docophorus scalaris N.; Giebel, 1866, Z. ges. Nat. Wiss. **28**: 360. Host: *Picus minor*.

- Docophorus macrotrichus* Kolenati, 1858, S. B. Akad. Wiss. Wien **29**: 248, Pl. 1, Fig. 5. Host: *Chrysophlegma flavinucha*. NEW SYNONYMY.
- Penenirmus macrotrichus* (Kolenati); Hopkins and Clay, 1952, check list of general and species of Mallophaga: 275. Host: *Picus flavinucha* Gould.
- Picophilopterus tuktola* Ansari, 1947, Proc. natl. Inst. Sci., India **13**: 265, Fig. 4. Host: *Picus s. squamatus* Vigors. NEW SYNONYMY.
- Penenirmus tuktola* (Ansari); Hopkins and Clay, 1952, Check list of genera and species of Mallophaga: 276. Host: *Picus s. squamatus*. NEW SYNONYMY.

In general appearance this species closely resembles *P. auritus* from which it is distinguished by the greater number of centroposterior setae on tergites and the elongate forehead.

The head (Fig. 12) is produced in front as in *P. serrilimbus*, though it has only 2 pairs of elongate temporal setae. The stout anterior dorsal setae of the forehead are short. The proportions of the thorax and abdomen (Figs. 3, 4) are similar to *P. auritus*. Centroposterior of tergites IV–VI total more than 16 (\bar{x} 8/tergite). Sternites IV–VI with less than 9 centroposterior setae (\bar{x} 2/sternites).

Neoparatypes of *P. pici*, selected by Clay and Hopkins (1960: 7), have been examined. The paratypes of *P. tuktola* examined are not significantly different from either *P. pici* or *P. macrotrichus*, though specimens from the type host of the latter were consistently larger than the series from other hosts.

Dimensions in mm.: Total length, male 1.72–2.18, female 2.18–2.64; head length, male 0.53–0.67, female 0.61–0.74; head width, male 0.47–0.58, female 0.52–0.66; prothorax width, male 0.28–0.37, female 0.31–0.40; pterothorax width, male 0.43–0.62, female 0.54–0.67; abdominal width, male 0.54–0.82, female 0.70–0.90.

Material examined: Neotype and 5 males, 5 females from *Picus viridis* Linn. from England, Sweden and Yugoslavia; 9 males, 15 females from *Picus vaillantii* (Malherbe) from Morocco; 1 male, 1 female from *Picus s. squamatus* Vigors from Pakistan; 3 males, 6 females from *Picus vittatus* Vieillot from Thailand; 7 males, 9 females from *Picus vittatus eisenhoferi* Gyldenstolpe from Thailand; 4 males, 4 females from *Picus canus* Gmelin from Thailand; 4 males, 1 female from *Picus c. canus* Gmelin from Estonia; 2 males, 2 females from *Picus canus gyldenstolpei* S. Baker from Nepal; 1 male, 4 females from *Picus canus hessei* Gyldenstolpe from Thailand; 6 males, 8 females from *Picus erythropygius* (Elliot) from Thailand; 2 males, 3 females from *Picus flavinucha* Gould from Thailand; 1 male, 1 female from *Picus flavinucha archon* Deignan from Thailand; 1 male, 1 female from *Picus flavinucha lylei* (Kloss) from Thailand; 5 males, 5 females from *Picus flavinucha pierreii* Oustalet from Thailand; 4 males, 4 females from *Picus chlorolophus laotianus* Delacour from Thailand; 1 female from *Picus mentalis humii* (Hargitt) from

Thailand; 8 males, 14 females from *Dinopium b. benghalense* (Linn.) from India; 8 males, 8 females from *Dinopium b. puncticolle* (Malherbe) from India; 8 males, 8 females from *Dinopium javanense* (Ljungh) from Philippine Islands and Thailand; 1 female from *Dinopium j. javanense* (Ljungh) from Thailand; 2 males, 2 females from *Dinopium j. intermedium* (Blyth) from Thailand; 1 male, 4 females from *Gecinulus grantia grantia* (McClelland) from Thailand; 2 females from *Gecinulus grantia viridanus* Sclater from Burma; 1 male from *Mulleripicus pulverulentus harterti* Hesse from Thailand; 1 male, 1 female from *Mulleripicus p. pulverulentus* (Temminck) from Thailand; 4 males, 4 females from *Dryocopus javensis jeddeni* (Blyth) from Thailand; 6 males, 10 females from *Blythipicus p. pyrrhotis* (Hodgson) from Nepal; 2 females from *Chrysocolaptes lucidus guttacristatus* (Tickell) from Thailand.

Penenirmus heteroscelis (Nitzsch, 1866)

(Figs. 5, 6, 14)

Type host: *Dryocopus martius martius* (Linn.)

Nirmus heteroscelis Nitzsch, 1866, Z. ges. Nat. Wiss. **27**: 118. Host: *Pico martio*.

Degeeriella heteroscelis (Nitzsch); Seguy, 1944, Faune de France **43**: 310. Host: *Picus martius*.

Penenirmus heteroscelis (Nitzsch); Hopkins and Clay, 1952, Check list of general and species of Mallophaga: 274. Host: *Dryocopus m. martius*. (*pici* Schrank and *kumagera* Uchida placed as synonyms)

Paranirmus heteroscelis (Nitzsch); Zlotorzycza, 1964, Acta Parasit. Polonica **12**(24): 275, photo 20. Host: *Dryocopus martius*.

Pediculus pici Schrank, 1803, (nec Fabricius, 1798), Fauna boica: 188. Host: Schwarzspecht.

Phlopterus kumagera Uchida, 1949, Jap. Med. J. **1**: 544, Fig. 12. Host: *Dryocopus m. martius*.

Penenirmus accuratus Zlotorzycza, 1964, Acta Parasit. Polonica **12**(24): 271, Figs. 9a, 9b. photo. 16. Host: *Dryocopus m. martius*. NEW SYNONYMY.

This distinctive species is identified by the elongate dorsal anterior setae of the forehead.

The head (Fig. 14) is similar in proportions to *P. arcticus* though significantly larger. The preantennal length is noticeably shorter than the postantennal length of the head.

The single female examined had more thoracic and abdominal setae than either of the 2 males. Pterothorax with a centroposterior group of 3 (male) or 4 (female) elongate setae on each side. General form (Figs. 5, 6) similar to *P. campephili*, though lacking the broad pleural thickenings of the latter

species. Tergites III–VI each with 6–8 (male) or 6–10 (female) elongate centroposterior setae and 2 shorter centroposterior setae on sternites III–VI.

The Nitzsch collection was destroyed during World War II. There has been no subsequent neotype selected for *Nirmus heteroscelis* Nitzsch, 1866. The pair examined from the type host; *Dryocopus martius* are hereby designated as Neotypes. They are in good condition and agree with the original description and the concept in common use during the last hundred years. The Neotype male and neoparatype female, from *Dryocopus martius* (Linn.) from Nischninovgorad, U.S.S.R., Apr., 1926, W. W. Karpoff, Col. No. 34., are deposited in the British Museum (Natural History). Figures are of these specimens.

Through the kindness of Dr. Göllner-Scheiding of the Zoologisches Museum der Humboldt-Universität, I have been able to examine the single male on which *Paranirmus* Zlotorzycza, 1964, is based. It differs from the neotype of *P. heteroscelis* only in features perhaps best attributed to the techniques of mounting. It resembles specimens which have been preserved in alcohol for a considerable time, then only partially macerated and placed in a thick mount of Canada balsam. The discernible chaetotaxy does not differ from that for Figure 6.

The description of *P. accuratus* Zlotorzycza, 1964, is neither adequate nor diagnostic. In the absence of any evidence to the contrary, I have therefore considered it to be conspecific with *P. heteroscelis*.

Dimensions in mm.: Total length, male 1.70, female 2.11–2.15; head length, male 0.55–0.59, female 0.61–0.62; head width, male 0.52–0.56, female 0.58–0.61; prothorax width, male 0.30–0.32, female 0.32–0.36; pterothorax width, male 0.52–0.56, female 0.56–0.62; abdominal width, male 0.72–0.75, female 0.80–0.82.

Material examined: 3 males, 2 females from *Dryocopus martius* (Linn.) from Poland and U.S.S.R.

Penenirmus jungens (Kellogg, 1896)

Type host: *Colaptes auratus luteus* Bangs

Docophorus jungens Kellogg, 1896, Occ. Pap. Calif. Acad. Sci. (2), 6: 481, Pl. 66, Fig. 4. Host: *Colaptes auratus* (Linn.).

Philoferus jungens Kellogg; Harrison, 1916, Parasitology 9: 97. Host: *Colaptes auratus*.

Penenirmus jungens (Kellogg); Hopkins and Clay, 1952, Check list of genera and species of Mallophaga: 275. Host: *Colaptes auratus luteus* Bangs.

Penenirmus villosus Emerson and Johnson, 1961, J. Kansas ent. Soc. 34: 41, Figs. 13, 15, 32. Host: *Dendrocopos v. villosus* (Linn.) (probable error). NEW SYNONYMY.

This species is somewhat intermediate between *P. auratus* and *P. pici* and

can be distinguished from them only by the 3 pairs of elongate centroposterior setae on the pterothorax.

The proportions of the head and abdomen are similar to *P. auritus*, as is the abdominal chaetotaxy, except that in *P. jungens* tergites III–VI typically have 3 pairs of centroposterior setae.

Carriker (1957:97) selected “. . . the female (in best condition) on slide No. 309a as lectotype.” Slide 309a has 1 male and 2 females. It has been remounted and the female on the right is designated as lectotype, the others thus becoming paralectotypes. One male and 2 females on a second slide numbered 310a and otherwise labeled as 309a, have been remounted and labeled as paralectotypes. The above types have been returned to the Kellogg Collection, at the University of California, at Berkeley.

Penenirmus villosus is based on a mixed series. The holotype, allotype and 2 paratypes are indistinguishable from *P. jungens*, whereas 10 male and 7 female paratypes examined are identical to *P. auritus*. It is likely that the series including the holotype and 3 paratypes are stragglers off *Colaptes auratus*; all other paratypes will likely prove to be *P. auritus*, which normally infests *Dendrocopos villosus*.

Dimensions in mm.: Total length, male 1.54–2.08, female 1.80–2.32; head length, male 0.52–0.61, female 0.56–0.64; head width, male 0.47–0.56, female 0.49–0.62; prothorax width, male 0.26–0.33, female 0.27–0.34; pterothorax width, male 0.40–0.58, female 0.44–0.63; abdominal width, male 0.54–0.74, female 0.68–0.85.

Material examined: 6 males, 5 females from *Colaptes cafer* (Gmelin) from Mexico and U.S.A.; 3 males, 6 females from *Colaptes cafer collaris* Vigors from U.S.A.; 35 males, 54 females from *Colaptes auratus* (Linn.) from Canada and U.S.A.; 5 males, 15 females from *Colaptes auratus luteus* Bangs from U.S.A.; 1 female from *Colaptes chrysoides mearnsi* Ridgeway, from U.S.A.; 2 males, 2 females from *Dendrocopos villosus* (Linn.) (probable error) from U.S.A.

Penenirmus campephili Eichler, 1953

(Figs. 7, 8, 13)

— Type host: *Campephilus magellanicus* (King)

Penenirmus campephili Eichler, 1953, Zool. anz. **150**: 239, figs. 16, 17. Host: *Campephilus magellanicus*.

This species (Figs. 7, 8) is readily distinguished from others known from the Picidae by the presence of 2 pairs of pleural setae on segments IV–V and 4 sternocentral setae on each abdominal segment.

The preantennal length of the head (Fig. 13) is approximately equal to the postantennal length. Dorsal anterior setae of forehead short. Pterothorax with 3 pairs of elongate centroposterior setae, as in *P. jungens*. Tergites III–VI

each with 8–10 centroposterior setae and sternites III–VI each with an average of centroposterior setae.

Dimensions in mm.: Total length, male 1.90, female 1.96–2.27; head length, male 0.59, female 0.62–0.66; head width, male 0.58, female 0.62–0.64; prothorax width, male 0.36, female 0.35–0.38; pterothorax width, male 0.61, female 0.61–0.70; abdominal width, male 0.77, female 0.79–0.88.

Material examined: 2 male, 4 female paratypes from *Campephilus magellanicus* from Chile.

Penenirmus maculipes (Piaget, 1880)
(Fig. 8A)

Type host: "Picus from Bangka"

Docophorus maculipes Piaget, 1880, Pediculines: 661, Pl. 54, Fig. 54, Fig.

3. Host: *Picus* from Bangka.

Phlopterus maculipes Piaget; Harrison, 1916, Parasitology **9**: 98. Host: *Picus* sp.

Penenirmus maculipes (Piaget); Hopkins and Clay, 1952, Check list of genera and species of Mallophaga: 275. Host: *Picus* from Bangka.

Penenirmus maculipes (Piaget); Emerson and Johnson, 1961, J. Kansas ent. Soc. **34**: 42. Host: *Picus* from Bangka.

This species is based on a single female, in good condition, reportedly from a *Picus* from Bangka.

This species is readily distinguished from others known from the Picidae by the 4 pairs of centroposterior setae on the pterothorax, 10 elongate centroposterior setae on tergites III–V, and 9 on tergites VI–VII. Dorsally it resembles *P. campephilii* from which it is distinguished by its 2, as opposed to 4, centroposterior setae on sternites III–VI, and single pair of pleural setae on segments IV–V.

Dr. H. G. Deignan, U. S. National Museum, (*in* Emerson and Johnson, 1961:43) cites the following species as possibly being the "*Picus* from Bangka": *Picus puniceus observandus* (Hartert), *Picus mineaceus malaccensis* Latham, *Picus mentalis humii* (Hargitt), *Dinopium rafflesii rafflesii* (Vigors and Harsfield), *Micropternus brachyurus badius* (Raffles), *Hemicircus concretus coccomentopus* (Reichenbach), and *Dryocopus javensis javensis* (Horsfield). Specimens examined from *Picus mineaceus*, *Picus mentalis*, *Micropternus brachyurus* and *Dryocopus javensis* are not conspecific with the type and should not be considered as possible type host of *P. maculipes*. It is tempting to therefore conclude that the type host is either *Picus puniceus*, *Dinopium rafflesii* or *Hemicircus concretus* and furthermore, *Penenirmus pici* or *P. auritus* are known to infest *Picus* spp. and *Dinopium* spp., thus *Hemicircus concretus* appears to be the most probable type host of *P. maculipes*. This speculation however rests on the reliability of the original collection data. Hopkins and Clay

(1954) list the 496 species described by Piaget and cite 96 host records as being in error with another 15 listed as probable host errors. With approximately 20% of the Piaget host records known to be wrong it is neither prudent nor profitable to rely too heavily on a type host identified through such a process of elimination. The type host designation must await the collection of con-specific specimens which most likely will come from some southeast asian woodpecker.

Material examined: 1 female Holotype from *Picus* from Bangka (B.M. natural history).

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